

WHAT IS CLAIMED IS:

Sub  
B10

1 1. A computer-implemented method for restructuring a design model generated by a  
2 computer aided design system, the method comprising:  
3 receiving at a computer a command to restructure the design model, the design model  
4 comprising a first hierarchical data structure interrelating a plurality of components  
5 and the command to restructure comprising a command to change a hierarchical  
6 relationship of a first subset of the plurality of components with respect to other ones  
7 of the plurality of components;  
8 in accordance with the command to restructure, generating a new hierarchical data  
9 structure comprising a new hierarchical relationship between the plurality of model  
10 components;  
11 determining other relationships between components in the first data structure hierarchy  
12 that are changed as a result of the command to restructure; and  
13 dynamically updating the other relationships to preserve the other relationships  
14 subsequent to the generation of the new hierarchical relationship.

1 2. The method of claim 1 wherein the first hierarchical data structure comprises a plurality  
2 of parent-child relationships relating the plurality of components to a common root  
3 component, said parent-child relationships detailing a construction of the model.

1 3. The method of claim 2 wherein generating the new hierarchical data structure comprises  
2 changing a hierarchical path between the first subset and the root component.

1 4. The method of claim 3 wherein:  
2 the other ones of the plurality of components comprises a first other component;  
3 the other relationships comprise a first other relationship between one of the first subset  
4 of components and the first other component; and

5 the hierarchical path between the root component and the first other component is not  
6 changed as a result of the restructuring command.

1 5. The method of claim 4 wherein the first other relationship comprises a mate relationship  
2 and dynamically updating the other relationships comprises updating first other  
3 relationship data to maintain a mating between the one of the subset of components and  
4 the first other components.

1 6. The method of claims 5 wherein, prior to the restructure of the hierarchy, the first subset  
2 is a descendent of the first other components, and subsequent to the restructure, the first  
3 subset is not a descendent of the first other component.

1 7. The method of claim 4 wherein the first other relationship comprises an update  
2 relationship and dynamically updating the other relationships comprises updating data to  
3 maintain an updating relationship between the one of the first subset of components  
4 component and the first other component.

1 8. The method of claim 4 wherein the first other relationship establishes a size relationship  
2 between the one of the subset of components and the first other component.

1 9. The method of claim 4 wherein the first other relationship establishes a positional  
2 relationship between the one of the subset of components and the first other component.

1 10. The method of claim 1 wherein:  
2 generating the new hierarchical data structure comprises generating a component list  
3 identifying a component moving to a new location; and

4 updating the other relationships comprises generating a reference list identifying the other  
5 relationships that are changed.

1 11. The method of claim 10 wherein generating a reference list comprises associating a  
2 reference location code with each relationship identified by the reference list, each  
3 reference location code identifying a change to a relationship to preserve design intent  
4 associated with the relationship.

1 12. The method of claim 1 wherein the first subset of components comprise a subassembly of  
2 the model.

1 13. A computer program residing on a computer-readable medium, comprising instructions  
2 for causing a computer to  
3 receive a command to restructure a design model generated by a computer aided design  
4 system, the design model comprising a first hierarchical data structure interrelating a  
5 plurality of components and the command to restructure comprising a command to  
6 change a hierarchical relationship of a first subset of the plurality of components with  
7 respect to other ones of the plurality of components;  
8 in accordance with the command to restructure, generate a new hierarchical data structure  
9 comprising a new hierarchical relationship between the plurality of model  
10 components;  
11 determine other relationships between components in the first data structure hierarchy  
12 that are changed as a result of the command to restructure; and  
13 dynamically update the other relationships to preserve the other relationships subsequent  
14 to generation of the new hierarchical relationship by the instructions to generate.

1 14. The program apparatus of claim 13 wherein the first hierarchical data structure comprises  
2 a plurality of parent-child relationships relating the plurality of components to a common  
3 root component, said parent-child relationships detailing a construction of the model.

1 15. The program apparatus of claim 14 wherein the instructions to generate the new  
2 hierarchical data structure comprise instructions to change a hierarchical path between  
3 the first subset and the root component.

1 16. The program apparatus of claim 15 wherein:  
2 the other ones of the plurality of components comprises a first other component;  
3 the other relationships comprise a first other relationship between one of the first subset  
4 of components and the first other component; and  
5 the hierarchical path between the root component and the first other component is not  
6 changed as a result of the restructuring command.

1 17. The program apparatus of claim 16 wherein the first other relationship comprises a mate  
2 relationship and the instructions to dynamically update the other relationships comprise  
3 instructions to update the first other relationship data to maintain a mating between the  
4 one of the subset of components and the first other components.

1 18. The program apparatus of claims 17 wherein, prior to the restructure of the hierarchy, the  
2 first subset is a descendent of the first other components, and subsequent to the  
3 restructure, the first subset is not a descendent of the first other component.

1 19. The program apparatus of claim 16 wherein the first other relationship comprises an  
2 update relationship and the instructions to dynamically update the other relationships  
3 comprises instructions to update data to maintain an updating relationship between the  
4 one of the first subset of components component and the first other component.

1 20. The program apparatus of claim 16 wherein the first other relationship establishes a size  
2 relationship between the one of the subset of components and the first other component.

1 21. The program apparatus of claim 16 wherein the first other relationship establishes a  
2 positional relationship between the one of the subset of components and the first other  
3 component.

1 22. The program apparatus of claim 13 wherein:  
2 the instructions to generate the new hierarchical data structure comprise instructions to  
3 generate a component list identifying a component moving to a new location; and  
4 the instructions to update the other relationships comprises instructions to generate a  
5 reference list identifying the other relationships that are changed.

1 23. The program apparatus of claim 22 wherein the instructions to generate a reference list  
2 comprise instructions to associate a reference location code with each relationship  
3 identified by the reference list, each reference location code identifying a change to a  
4 relationship to preserve design intent associated with the relationship.

1 24. The method of claim 1 wherein the first subset of components comprise a subassembly of  
2 the model.

1 25. A computer aided drawing system comprising:

2 a database comprising a stored design model generated by a computer aided design  
3 system, the design model comprising a first hierarchical data structure interrelating a  
4 plurality of components;

5 an input device to exchange data with a user; and

6 a processor operatively coupled to the input device, to the database, and to a data storage  
7 medium, the data storage medium comprising instructions to configure the processor  
8 to:

9 receive from the input device a command to restructure the design model;

10 in response to the command to restructure, executing instructions to generate a new

11 hierarchical data structure comprising a new hierarchical relationship by changing

12 a hierarchical relationship of a first subset of the plurality of components with

13 respect to other ones of the plurality of components;

14 determine other relationships between components in the first data structure hierarchy

15 that are changed as a result of the command to restructure; and

16 dynamically update the other relationships to preserve the other relationships

17 subsequent to generation of the new hierarchical relationship.

1 26. The program apparatus of claim 25 wherein the first hierarchical data structure comprises

2 a plurality of parent-child relationships relating the plurality of components to a common

3 root component, said parent-child relationships detailing a construction of the model.

1 27. The system of claim 26 wherein the instructions to generate the new hierarchical data

2 structure comprise instructions to change a hierarchical path between the first subset and

3 the root component.

1 28. The system of claim 27 wherein:

2 the other ones of the plurality of components comprises a first other component;  
3 the other relationships comprise a first other relationship between one of the first subset  
4 of components and the first other component; and  
5 the hierarchical path between the root component and the first other component is not  
6 changed as a result of the restructuring command.

1 29. The system of claim 28 wherein the first other relationship comprises a mate relationship  
2 and the instructions to dynamically update the other relationships comprise instructions to  
3 update the first other relationship data to maintain a mating between the one of the subset  
4 of components and the first other components.

1 30. The system of claims 29 wherein, prior to the restructure of the hierarchy, the first subset  
2 is a descendent of the first other components, and subsequent to the restructure, the first  
3 subset is not a descendent of the first other component.

1 31. The system of claim 28 wherein the first other relationship comprises an update  
2 relationship and the instructions to dynamically update the other relationships comprises  
3 instructions to update data to maintain an updating relationship between the one of the  
4 first subset of components component and the first other component.

1 32. The system of claim 28 wherein the first other relationship establishes a size relationship  
2 between the one of the subset of components and the first other component.

1 33. The system of claim 28 wherein the first other relationship establishes a positional  
2 relationship between the one of the subset of components and the first other component.

1 34. The system of claim 25 wherein:  
2 the instructions to generate the new hierarchical data structure comprise instructions to  
3 generate a component list identifying a component moving to a new location; and  
4 the instructions to update the other relationships comprises instructions to generate a  
5 reference list identifying the other relationships that are changed.

1 35. The system of claim 22 wherein the instructions to generate a reference list comprise  
2 instructions to associate a reference location code with each relationship identified by the  
3 reference list, each reference location code identifying a change to a relationship to  
4 preserve design intent associated with the relationship.

1 36. The system of claim 25 wherein the first subset of components comprise a subassembly  
2 of the model.